NLC 210
Air-Cooled Argon-ion Laser

User's Manual

Complete with Operating Instructions
for the 9470 and 2270 Power Supply

NATIONAL LASER COMPANY

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CHAPTER 1 INTRODUCTION

Features
- Superior Beam Quality
- Low Noise
- Internal Mirror Design
- Extended Lifetime
- Drop-in Tube Replacement
- Designed for Fiber Optic Delivery
- Exceptional Warranty

Applications
- Flow Cytometry
- DNA Sequencing
- Confocal Microscopy
- Spectroscopy
- Hematology
- Photo Finishing
- Ultra High Speed Laser Printing
- Graphic Arts
- Semiconductor Inspection
- Basic Research

Design

The 210 argon laser has been engineered to meet today's most demanding needs in OEM applications. Offered in an industry standard rectangular package, the 210 provides unparalleled beam quality that is constant across output power levels and through fiber delivery systems. The 210 is also available with a remote cooling option for applications where fan vibration is a concern. The 210 also offers improved thermal stability, longer life and exceptionally low noise.

Quality

The 210 draws upon years of experience and proven results with major OEM's worldwide. Utilized in life science, image recording and research applications, the 210 has effectively proven to reduce warranty returns and increase lifetimes. The laser incorporates the latest in internal mirror tube technology assuring permanent beam alignment and eliminating contamination. NLC's design permits ease of servicing and simple, drop-in laser tube replacement.

CHAPTER 2 LASER SAFETY

CENTER FOR DEVICES AND RADIOLOGICAL HEALTH (CDRH) COMPLIANCE REQUIREMENTS

The following laser component conforms to the safety specifications and performance standards required of Class 3b lasers as defined by the Center for Devices and Radiological Health (CDRH)

-The National Laser Company 210 Series Product Line

MAINTENANCE REQUIRED TO KEEP THIS LASER PRODUCT IN COMPLIANCE WITH CENTER FOR DEVICES AND RADIOLOGICAL HEALTH (CDRH) REGULATIONS

The NLC 210 product line complies with Title 21 of the United States Code of Federal Regulations, Chapter 1, Subchapter J, Parts 1040.10 and 1040.11, as applicable. To maintain compliance, the operation of all features listed here should be verified annually or whenever the NLC 210 product line is subjected to adverse conditions.

1. Verify the beam attenuator (mechanical shutter) actually blocks exposure to laser radiation. If not, call the National Laser Company Customer Service Department (See Chapter 5)

2. Verify that the laser head has not been modified in any way. Modifications made by an OEM manufacturer to an NLC Laser Head violate compliance with CDRH standards and may also void any warranties.

WARNING:

The use of controls, adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure. The NLC 210 product line is a Class 3b - medium power laser whose beam is, by definition, a safety hazard. Avoid viewing the beam directly, or as reflected by a mirror or other polished surface. The 210 product line, when used in conjunction with compatible power supplies contains circuits that operate at dangerous voltages and current levels. **Avoid touching high voltage terminals or components. Internal measurements and/or adjustments should be made by qualified personnel only.**

PRECAUTIONS FOR SAFE OPERATION OF CLASS 3b - MEDIUM POWER LASERS

1. Establish a controlled area for laser operation: limit access to those trained in the principles of laser safety.

2. Post warning signs prominently near entrances to the laser operation area.

3. Set up shields to prevent the beam from escaping the laser operation area.

4. Set up a target to block the beam after it passes through the operating area.

5. Keep the protective cover on the laser head during operation.

6. Enclose the beam path whenever possible.

7. Keep the laser beam either above or below eye level.

8. Do not look at the beam directly or as reflected by a mirror or polished surface.

PRECAUTIONS FOR SAFE OPERATION OF THE LDI 9470 AND NLC 2270 POWER SUPPLY

1. In the final installation, the mains primary signals and ELV secondary signals of the "Mains", "Laser", and "Interface" connectors on the front panel must be isolated from the operator and accessible by SELV circuits.
   PRI = Primary Reference (Hazardous)
   ELV = Extra Low Voltage
   SELV = Safety Extra Low Voltage

2. A minimum of an approved method of reinforced or double insulation must be between any primary (PRI) hazardous and any extra low voltage (ELV) or safety extra low voltage (SELV) source at the connectors of the power supply.

3. Supplemental insulation is required between any ELV circuits and any user accessible circuits.

4. The electrical hazards of the power supply are the same as other electrical systems connected to the AC power line. Only a qualified technician should install the power supply. There are **NO** user serviceable parts within the power supply, therefore the cover of the power supply and any connected component should never be opened, as hazardous voltages may be present after the unit has been turned off.

Figure 2.1 Standard Safety Warning Label

WARNING!: The energy level of the laser beam is high enough to cause serious damage to the eye with possible loss of vision if the beam were to pass directly into the eye!

CDRH CONTROL DRAWINGS

The following labels are found on the 210 product line. These labels are important in identifying potential safety hazards and are in conformance to CDRH labeling requirements.

1. Aperture Label

2. Cover Avoid Exposure

3. Class 3b Danger

4. Danger Open Cover Class 3b

6. Model & Serial Number

9. CE Warning Labels Class 3b

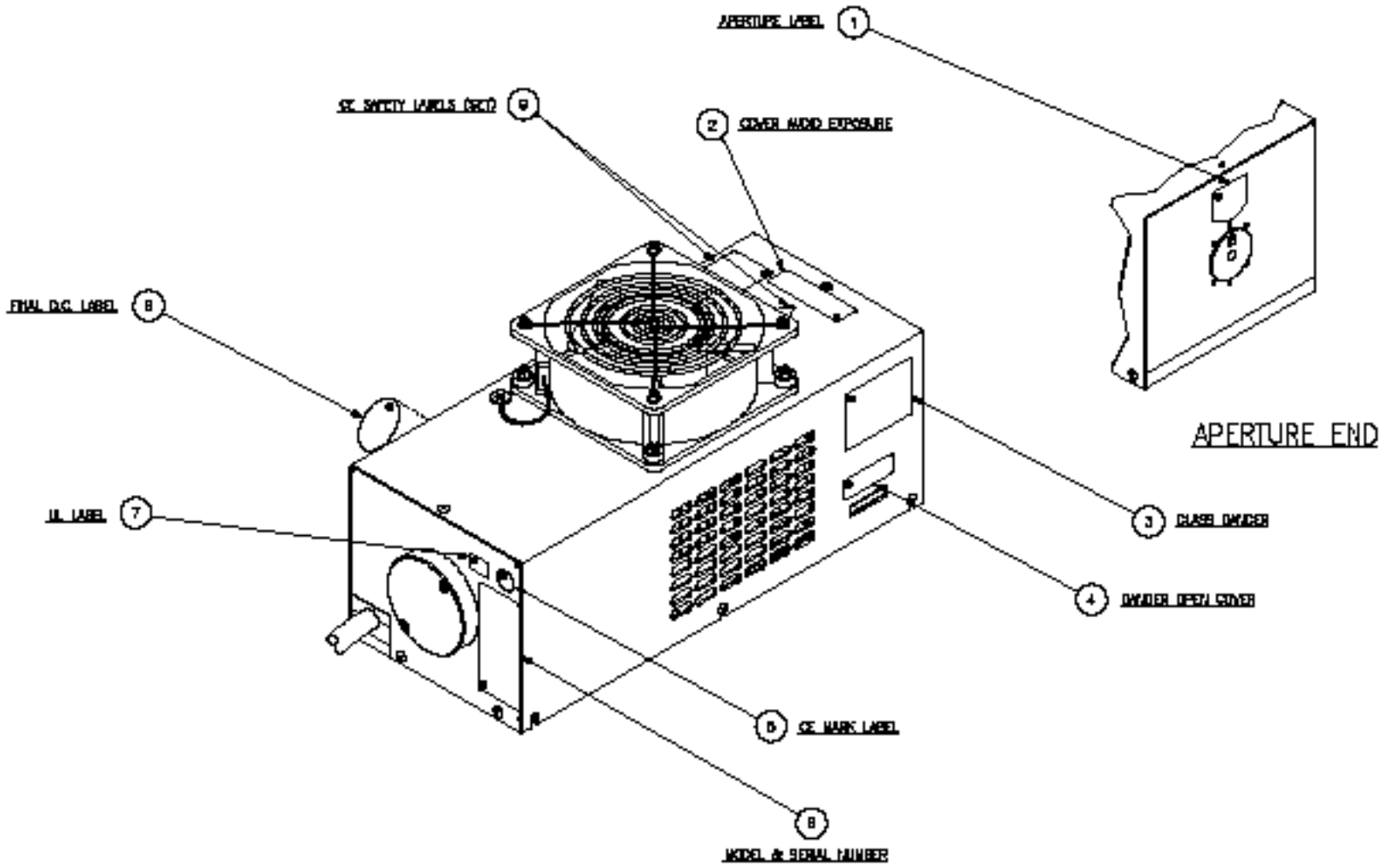
NON-CDRH Labels

7. UL Mark

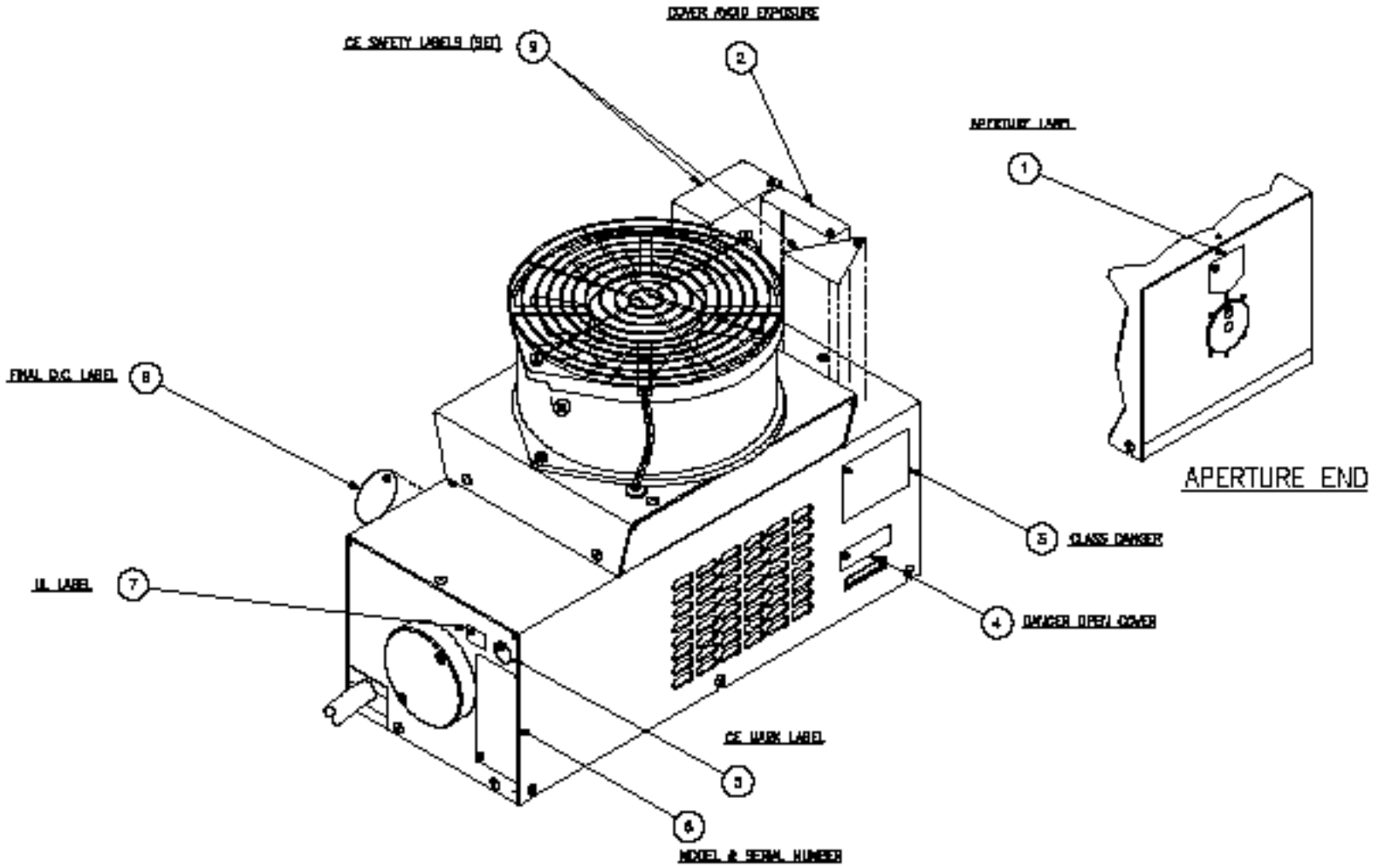
8. Final Q.C. Label

5. CE Mark

NLC 210 PRODUCT LINE LABELS



NLC 210 PRODUCT LINE (04, DUCT, & NO FAN COVER CONFIG.)
LABEL ILLUSTRATION



NLC 210 PRODUCT LINE (07 COVER CONFIG.) LABEL ILLUSTRATION

CHAPTER 3 NLC 210 PRODUCT LINE

This chapter contains information on the installation and operation of the National Laser Company (NLC) 210 product line of laser heads. Information regarding the specifications of the NLC 210 product line will also be given in this chapter. Figure 3.1 shows the NLC 210 Laser with the standard cover configuration (04 Fan).

Figure 3.1 The NLC 210 Series Laser

COOLING

The 210 product line is air-cooled. Fans draw cooling air through the openings at each side of the laser head and exhausts warm air vertically through the head cover. As mentioned in the "MOUNTING" section below, you will need to provide adequate space for air intake and exhaust, and must prevent heated exhaust air from returning to the intake. The laser is also available with a remote cooling option for applications where fan vibration is a concern.

HANDLING AND SHIPPING

When unpacking and carrying any laser head, lift it by the bottom base plate, and not by its fan, cover, or umbilical cord.

We recommend storing the container in which the 210 laser was shipped for future use. The container was specially designed to cushion laser equipment and prevent damage during shipment. If you need to return the laser head for service, the specially designed container will provide adequate protection.

MOUNTING

The NLC 210 product line of lasers should be mounted with the base horizontal and the fan up. Allow clearance for air intake at the sides and air exhaust at the top. Be sure to provide access to the mechanical shutter on the front of the laser. Mounting dimensions for the laser heads are shown on the "General Layout Drawing" at the end of this chapter.

CONNECTIONS

Note: The Laser Drive Model 9470 Power Supply will be referenced in the operating instructions of the NLC 210 product line. References made to the LDI 9470 power supply also apply to the NLC 2270 Power Supply.

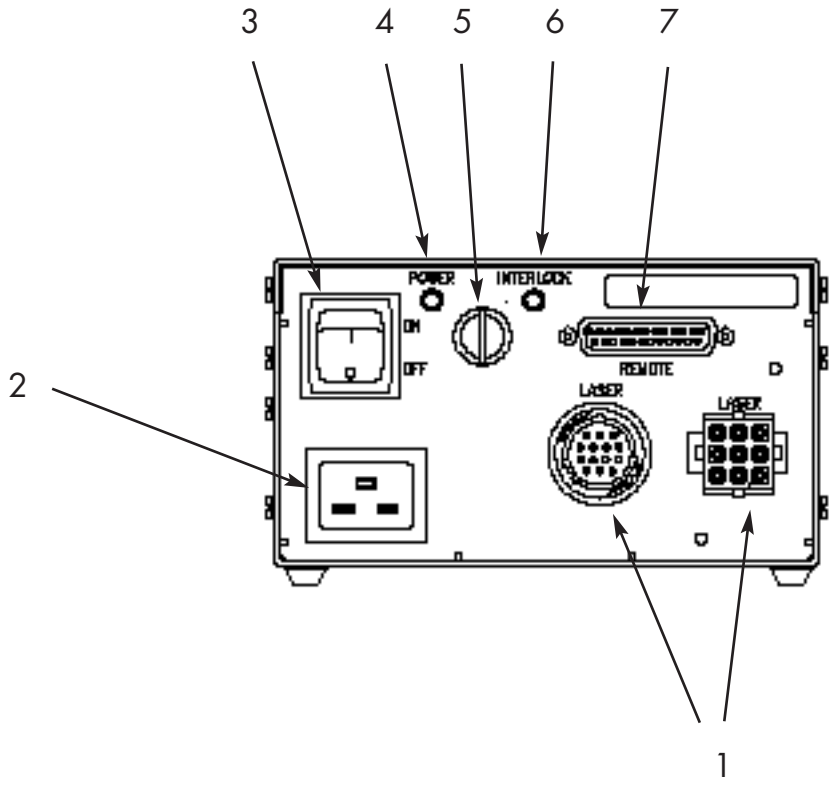


Figure 3.2 Front Panel Controls, Indicators and Connectors on the Laser Drive 9470 Power Supply

Location	Panel Description	Function
1	LASER HEAD (Connectors)	Receptacles for laser head umbilical cable.
2	100 - 240VAC Universal Input	Mains power cord.
3	POWER (Switch)	Mains power switch. Before activating this switch, ensure the LASER ON keyswitch (location 5) is in the OFF (rotated fully CCW) position and the INTERLOCK chain is complete. The mains power switch is activated by pressing the top of the rocker (marked "1"). This enables the INTERLOCK checking circuitry, lights the mains POWER light (location 4) and provides power to the laser head and power supply fans.
4	POWER (Red LED)	Indicates the mains POWER switch has been activated.
5	LASER ON (Key Switch)	Enables the laser discharge circuitry when rotated clockwise if the INTERLOCK chain is complete and the mains POWER switch is activated (in that order). It is a safety requirement that the key cannot be removed while the switch is activated.
6	INTERLOCK (Green LED)	Indicates the interlock chain is complete.
7	REMOTE INTERFACE (Connector)	Receptacle for remote control cable. (see Table 3.2 for pin connections)

Table 3.1 Front Panel Controls, Indicators, and Connectors on the Laser Drive 9470 Series Power Supply

Location	Status	Function
1	SELV	Interlock
2*	SELV	Discharge: Enable/Off
3	SELV	Interlock
4*	SELV	Standby: Run/Idle
5*	SELV	Mode: Photo/Current
6	SELV	Current Control Input
7	SELV	Photo Control Input
8	SELV	mW Output Sense
9	SELV	Current Output Sense
10	SELV	Ground - Common
11	SELV	Ground - Common
12	SELV	-15 Volts DC, 20mA Maximum
13	SELV	+15 Volts DC, 20mA Maximum
14	SELV	Ground - Common
15	SELV	No Connection
16	SELV	Display Signal (mW Sense Divided by 10)
17	SELV	No Connection
18	SELV	No Connection
19	SELV	No Connection
20	SELV	Ground - Common
21	SELV	Ground - Common
22	SELV	Ground - Common
23*	SELV	No Connection (Optional Remote On/Off Switch)
24	SELV	Ground - Common
25	SELV	Ground - Protective Earth

Table 3.2 Remote Interface Pin Connections for the Laser Drive 9470 Power Supply

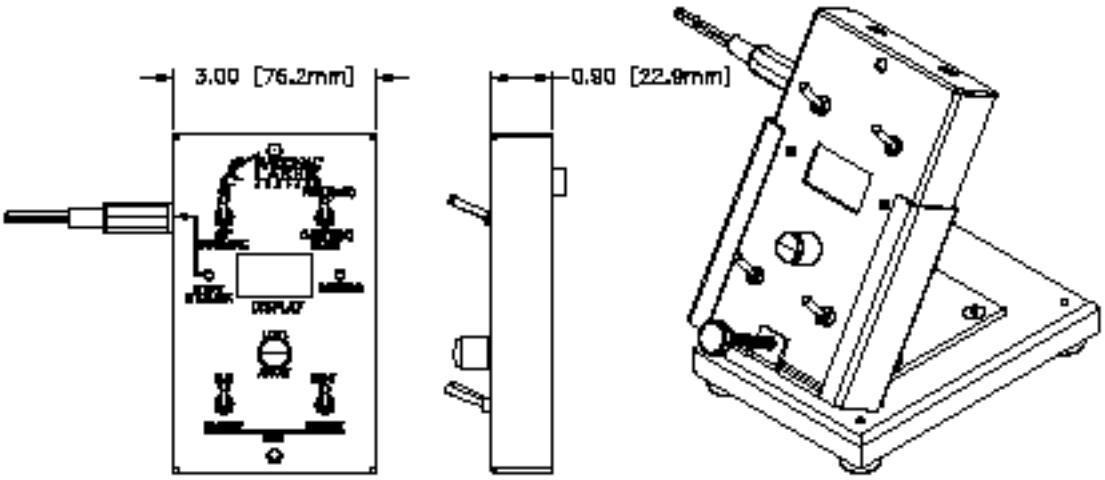
*These pins are digital inputs. Each input has a "pull up" resister to the internal +15 vdc buss. A logic '1' (high) is "open circuit" or between +12 and +15 vdc. A logic '0' (low) is "shorted" to GROUND or between 0 and +3 vdc. These inputs are compatible with "open collector" TTL outputs or CMOS outputs (when CMOS gates are operated from a +15 vdc supply), mechanical switches and relay contacts. However, they are most typically operated in a "hard wired" condition using manually placed shorting jumpers.

The power supply should never be energized unless the laser head is connected. Make sure that the key and rocker switch are turned to their off positions before making any connections.

Plug the umbilical cables from the laser head into the umbilical connectors (these connectors are marked "**LASER**" on the 9470 series) on the power supply. Make sure the locking ring is secure on the left connector and that the right connector is securely attached.

OPTIONAL REMOTE CONTROL

The 210 laser system is available with an optional remote control for use as a stand-alone system. The model 1000 and 2000 remote controllers allow the user to monitor and control output power and laser current. The model 1000 remote controller is compatible with power supplies that are running lasers rated for ≤100mW output power. The model 2000 remote controller is compatible with power supplies that are running lasers rated for >100mW output power. A remote stand is also available for more simplified operation. Remote controls include a plug for remote interlock purposes.



NLC 1000 or 2000 remote control w/ optional stand

REMOTE CONTROL OPERATION

Discharge switch - Must be in the ON position for the laser to emit light. There is a delay of 20-40 seconds before emission.

Emission LED - will be illuminated when the Mains Power switch is in the on position indicating possible laser radiation

Run/Standby switch - selects either run or standby mode. Run mode allows the current/output power to be adjusted with the Level Adjust knob. In Standby mode the laser runs at minimum current/output power.

Light/Current switch - selects either current or light mode. Light mode regulates the laser output power. Current mode runs the laser at a constant current.

Level Adjust knob - sets the output power when running in the Light mode, sets the laser current when running in Current mode (see Light/Current switch).

Display - displays tube current or laser output power in mW depending on the position of the Meter switch.

Meter switch - selects either Power (mW) or Current (Amps) to display.

Remote Interlock - This connector is to complete the remote interlock circuit. The LED will be illuminated if the interlock is complete.

ENERGIZING THE LASER

Electronic controls on the power supply make start-up and operation of the 210 product line safe and nearly automatic. If your system is controlled by a host system, no adjustment is necessary. If using the laser in a stand alone system, a remote or interlock connector is necessary. The output setting is the only adjustment that needs to be made on the remote. The front panel on the power supply's controls and indicators are shown in Figure 3.2 and explained in Table 3.1.

1. Set the power supply controls as follows:
   POWER switch 0 (OFF)
   LASER ON switch Fully CCW (OFF)

2. Open the mechanical output shutter.

3. Turn the Power switch ON. Check that the fan in the power supply is operating, and both the LED's are on.

4. Verify the laser fan is operating and drawing air through the laser head and ducting.

5. Turn the LASER ON key switch fully CW. (ON)

6. There should be an output beam from the laser within 20-40 seconds.

TURNING OFF THE LASER

1. Turn the LASER ON key switch fully CCW. (OFF)

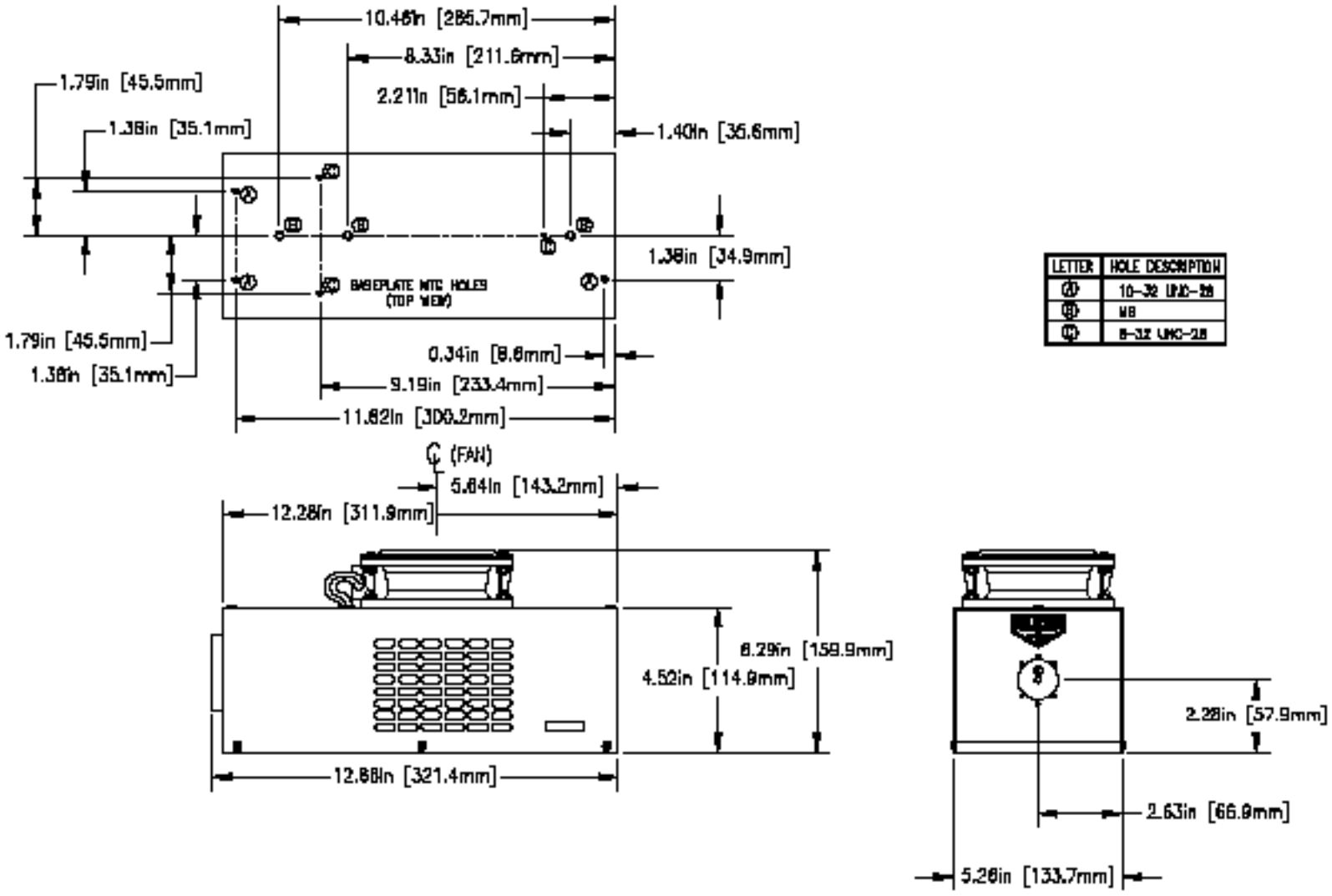
2. Wait several minutes while the fans cool the laser and power supply.

3. Turn off the POWER switch.

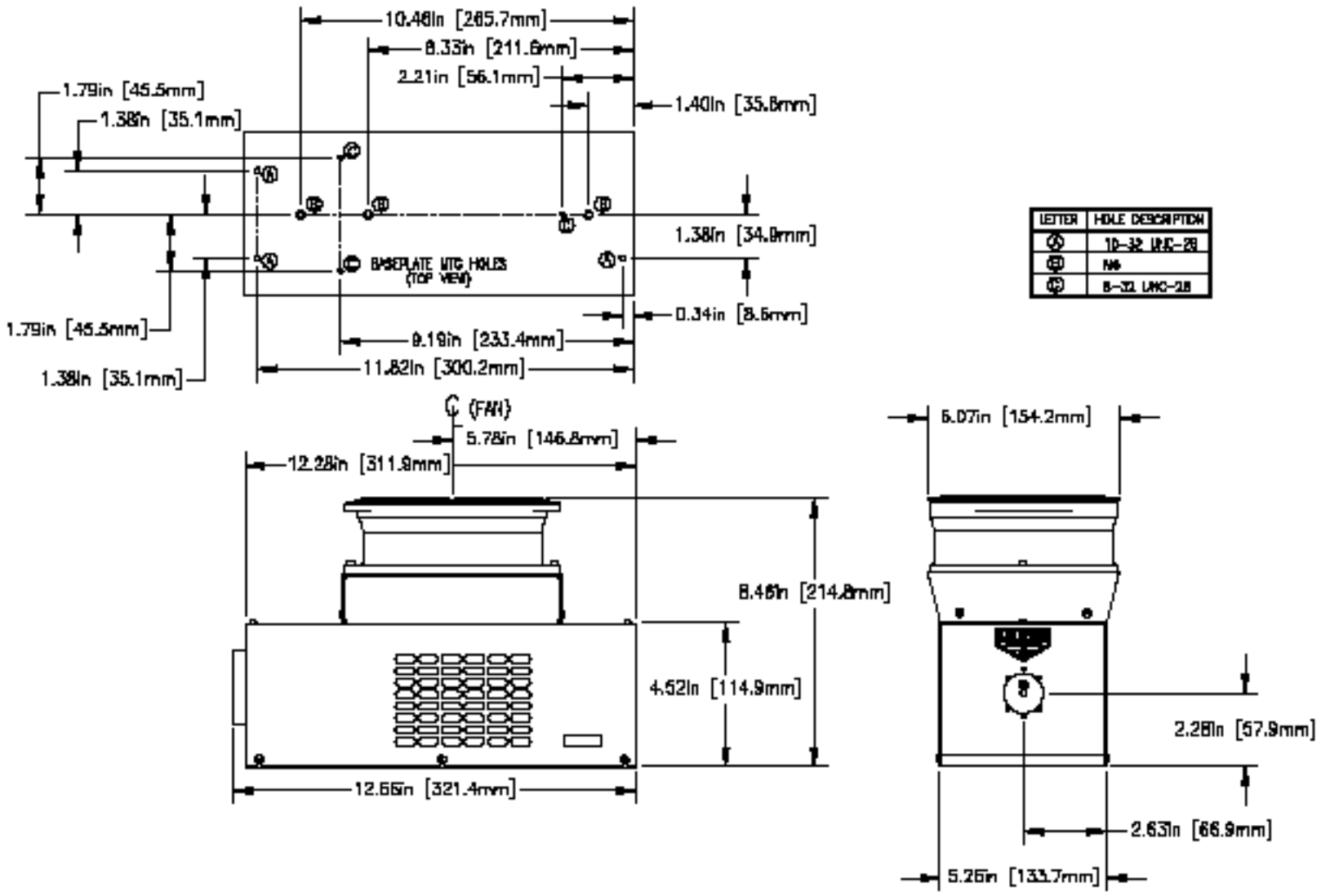
210 Product Line Specifications

Product Specifications[1,2,3]	**210DB**	**210BL**	**210GL**	**210AL**
Wavelength	458nm	488nm	514nm	458-514nm
Output Power	5mW	15,20,30mW	10,15,20mW	25,40,65mW
Power Stability (over 2 hours)	±1%	±1%	±1%	±1%
Spatial Mode	TEM_{00}	TEM_{00}	TEM_{00}	TEM_{00}
M^2	≤1.2	≤1.2	≤1.2	≤1.2
Beam Diameter @ $1/e^2$ (mm)	0.63±5%	0.65±5%	0.67±5%	0.67±5%
Beam Divergence (mrad)	<1.0	<1.0	<1.0	<1.0
Polarization Ratio	>250:1	>250:1	>250:1	>250:1
Pointing Stability over 2 hours (µrad)	±30/±3°C	±30/±3°C	±30/±3°C	±30/±3°C
Noise (20Hz - 2kHz peak to peak)	0.1%	0.1%	0.1%	0.1%
Noise (20Hz - 20kHz peak to peak)	1.0%	1.0%	1.0%	1.0%
Noise (20Hz - 2MHz rms)	1.0%	1.0%	1.0%	1.0%
Operating Parameters				
Voltage (Universal Input)	100-240VAC±10%			
Current	16 Amps Max.			
Frequency	47-63 Hz			
Phase	Single			
Air Intake (Standard, Large, Remote Cooling[4])	106, 225, 65 CFM			
Air Intake Clearance	2.5cm (1in)			
Operating Temperature / Humidity	4-40°C (40-105°F) / ≤90%			
Storage Temperature / Humidity	-30-60°C (-22-140°F) / ≤100%			
Warm-up Period	10 min.			
Dimensions				
Laser Head	12.69" x 5.26" x 6.3"			
Power Supply	11" x 6.38" x 3.85"			
Weights				
Laser Head (Std, Lrg, Remote Fan)[5]	10.8, 12.5, 9.5 lbs (4.9, 5.7, 4.3 kg)			
Power Supply	7 lbs (3.18 kg)			

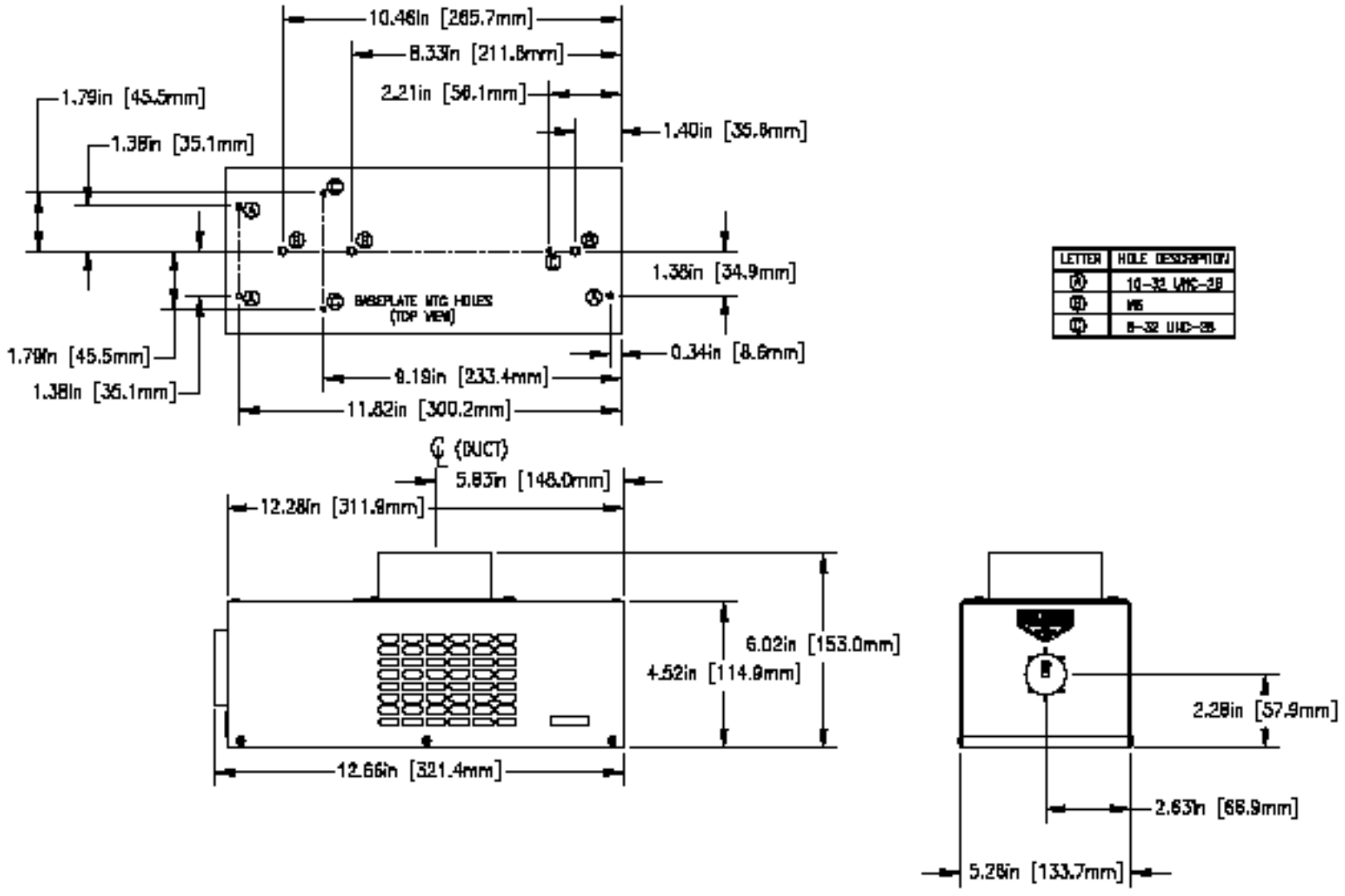
Notes
1. Specifications subject to change without notice.
2. When used with LDI 9470 or NLC 2270 power supply.
3. Measurements taken in light control after 5 minute warm-up.
4. Nominal air flow is 65 CFM. Use McLean Engineering Model INB412 or equivalent fan rated for 185 CFM free air flow and 1.8 inches of water. Hose length not to exceed two meters.
5. Large fan required for 30, 20, & 65mW @ 488, 514, & 458-514nm options.



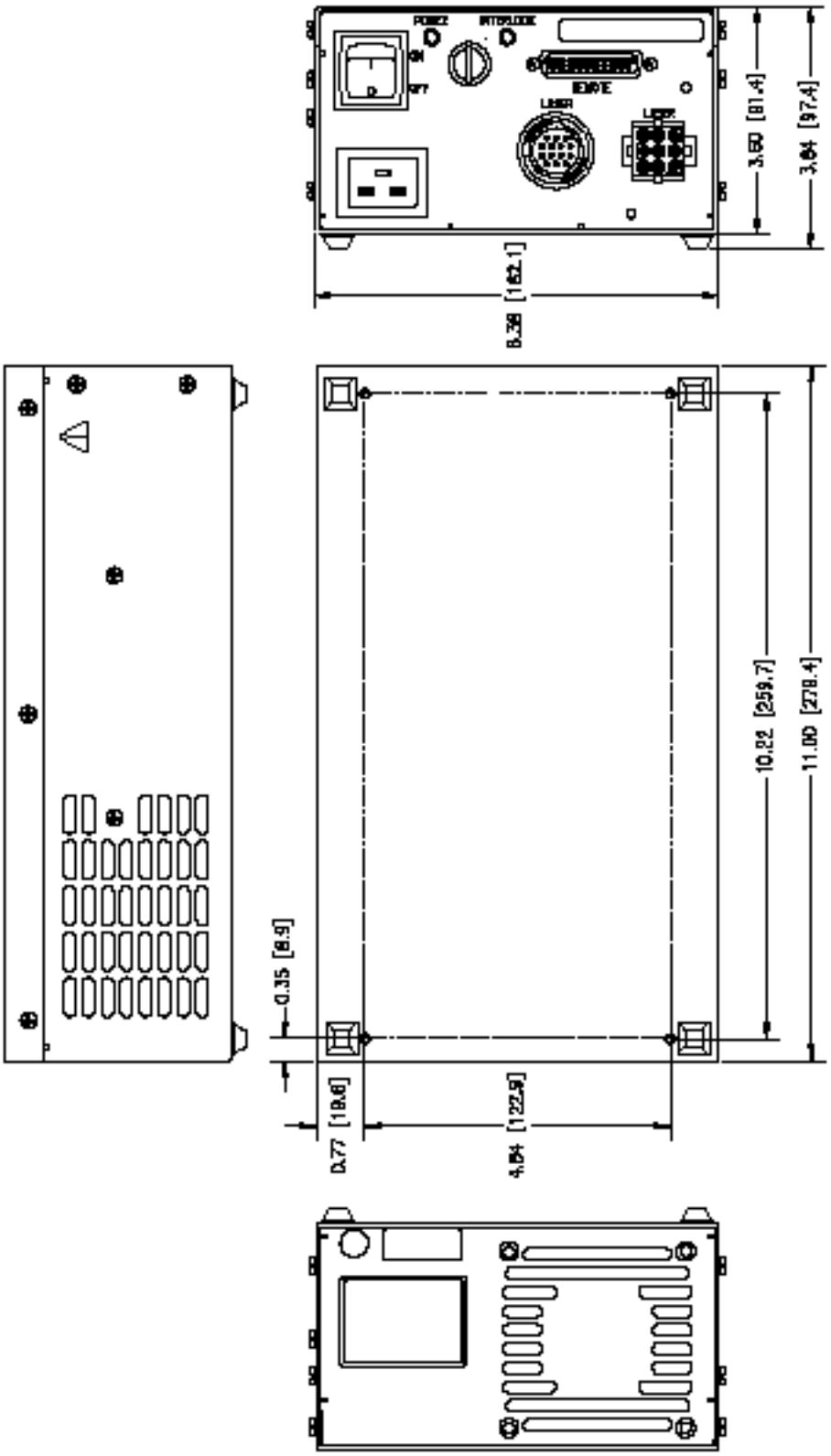
NLC 210 PRODUCT LINE LAYOUT DRAWING (04 COVER CONFIG.)



NLC 210 PRODUCT LINE LAYOUT DRAWING (07 COVER CONFIG.)



NLC 210 PRODUCT LINE LAYOUT DRAWING (DUCT COVER CONFIG.)



9470 POWER SUPPLY LAYOUT DRAWING

CHAPTER 4 TROUBLESHOOTING GUIDE

Below is a list of troubleshooting tips to help you with any questions or problems you may have regarding your NLC product. If your question isn't answered here, contact our customer service department for help.

Trigger does not audibly click to light laser head

1. Check the interlock circuit. On most power supplies, this may be done by checking that the green interlock light is still lit after 2 minutes.
2. Make sure that all connections to the power supply and power source are securely attached
3. Make sure the emission key switch is turned to the fully CW position.
4. Make sure the input voltage is correct and is adequate for running the laser.
   (If all the above checks out, contact NLC)

An Audible click is heard but the head fails to light

1. Verify all connections are securely fastened
2. Make sure the input voltage is correct
   (If all the above checks out, contact NLC)

Insufficient or low power

1. Verify that the aperture at the front of the laser head is in the fully open position.
2. Verify that the power supply mode switch (if applicable) is in light control mode
3. Check that the current is not above 9 amps
4. Check that customer requirements do not exceed rated head output.

   Standard operating specifications may be found in user's manuals, datasheets, or the NLC website. (www.nationallaser.com)

Head lights but shuts down in a short period of time (30 seconds to ten minutes)

1. Check that the cooling fan is drawing air through the head.
2. Check that the green interlock light on the power supply (if applicable) is lit. If not, a possible thermal failure exists.
3. If the head shuts down due to thermal failure, the system must be completely shut down and re-energized.

CHAPTER 5 CUSTOMER SERVICE

CUSTOMER SERVICE DEPARTMENT

In the event that further assistance is required regarding any product of National Laser Company, please direct you questions to the customer service department of:

National Laser Company
175 West 2950 South
Salt Lake City, UT 84115 USA
Tel: 801 467-3391
Fax: 801 467-3394
Email: laser@nationallaser.com
www.nationallaser.com

WARRANTY INFORMATION

NOTICE:

The warranty information contained in this section is intended for use as a general reference. Specific warranty information can be found in the customer service contract. The terms of the contract take precedence over the warranty information contained herein.

LIMITED WARRANTY FOR NATIONAL LASER COMPANY PRODUCTS

NATIONAL LASER COMPANY ("NLC") expressly warrants its:

210 product line to be free from defects in materials or workmanship for five-thousand (5,000) hours of operation or a period of twelve (12) Months from the date the laser head is first shipped, whichever comes first.

LIMITATION OF REMEDY

The exclusive remedy available under this warranty shall be the repair of any defects in an NLC product caused by inadequate workmanship or materials or the replacement of the defective material, so long as the following conditions precedent are satisfied by the customer:

1. The defective product shall be returned to NLC in accordance with instructions given by NLC and after a return authorization number has been issued to the customer by NLC

2 The warranty shall be limited to inherent defects in the product and shall not extend to any damage caused by improper use or handling by the customer or due to operating conditions outside of standard operating specifications.

3. The warranty shall be void if the original product identification markings have been removed, defaced or altered, or if any parts have been substituted, changed, or modified without the express written consent of NLC.

4. The customer's general account with NLC is current and not delinquent in whole or in part.

DISCLAIMER OF IMPLIED WARRANTY

THE FOREGOING IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, AND THERE ARE NO WARRANTIES OF MERCHANTABILITY OR FITNESS OR ANY OTHER REMEDIES AVAILABLE OTHER THAN AS EXPRESSED HEREIN.

RETURNS, ADJUSTMENTS AND SERVICING

If a customer requests a warranty or general repair on an NLC product, and NLC has authorized its return, the repair or service will be subject to the following conditions:

1. The product must be packed in the original shipping container. Additional shipping containers may be purchased from NLC, if needed.

2. The product shall be shipped back to NLC by air freight unless another means of transportation is specified in writing by NLC. Freight and insurance charges must be prepaid by the customer and all risk of loss, damage or delay in shipping shall be borne solely by the customer. Shipments will be insured for full value.

3. After the receipt of the product, NLC reserves the right to inspect the product and to determine the cause of failure and whether the repair or replacement should be completed under warranty. NLC SHALL HAVE NO OBLIGATION TO PERFORM A WARRANTY REPAIR WHERE THE PRODUCT HAS SUFFERED DAMAGE IN SHIPMENT THAT PREVENTS A VERIFICATION BY NLC THAT THE CAUSE OF EXISTENCE OF THE DEFECT IS COVERED UNDER WARRANTY.

4. If NLC determines a product is to be repaired under warranty, it will be repaired or replaced, in accordance with the terms of the NLC warranty. Products repaired under warranty will be shipped to locations within the United States at customer expense. Shipping, insurance, taxes, duties, and all other charges shall be charged to the customer if the product is returned to a location outside of the United States; provided that if the product fails within 30-days of the customer's receipt of the product and the customer gives written notice of the failure to NLC within said 30-day period, NLC will pay the cost of shipping the replacement product to the customer.

5. If NLC determines that the repair or service of a product is not to be completed under warranty, the customer will be advised and a purchase order from the customer for the repair work or service work will be required before NLC will commence the repair or service work on the product.

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